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NASA TECHNOLOGY TRANSFER

Report of the Technology Transfer Team

J. Creedon	LaRC
K. Abbott	LaRC
L. Ault	HQ-C
C. Ginty	LeRC
G. Mosakowski	KSC
S. Shariq	ARC
W. Spuck	JPL

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TECHNOLOGY TRANSFER TEAM

This document is the report of the NASA institutional team on technology transfer. The team was commissioned in a memo from Col. Bolden on May 7, 1992. This memo named J. F. Creedon of Langley Research Center as chairman. Shortly thereafter the team was selected from members nominated by Headquarters offices and the centers. The full committee membership is as shown on the facing vu graph. The committee held its first meeting on June 22, 1992 and completed its activities October 9, 1992.

The objective of the team was to assess the NASA technology transfer processes and to make recommendations for improving those processes. The team did find several problems and make a number of specific recommendations for improvement. It should be noted that the team felt that the problems were in the processes and policies concerned with technology transfer and not with the people involved - many of whom have worked diligently and with little encouragement or reward.

This report contains the team's assessment and recommendations. A very quick survey of the report can be accomplished by reading pages 11, 12, 22, and the recommendations. The attachments contain the specific details of the recommendations.

TECHNOLOGY TRANSFER TEAM

Dr. Jeremiah F. Creedon (Chairman)
Director for Flight Systems
NASA Langley Research Center

Dr. Kathy H. Abbott (Deputy Chairman)
Head, Human/Automation Integration Branch
NASA Langley Research Center

Mr. Leonard A. Ault
Deputy Director,
Technology Transfer Division
Office of Commercial Programs
NASA Headquarters, Code CU

Ms. Carol A. Ginty
Deputy Project Manager,
HITEMP Project Office
NASA Lewis Research Center

Mr. George E. Mosakowski
Manager of New Initiatives, Code PT
John F. Kennedy Space Center, NASA

Dr. Syed Z. Shariq
Assistant to the Deputy Director,
for Science and Industry
NASA Ames Research Center

Dr. William H. Spuck, III
Manager, Commercial Program
Jet Propulsion Laboratory

OUTLINE

This presentation consists of six primary parts.

The first is a definition of technology transfer. The team developed its own definition (on page 4) which helped a great deal to focus discussions.

The next part of the report clarifies the relationship between this team and the Technology Integration Team. This relationship was worked out iteratively over several discussions between the team chairmen.

Next, the team developed an overall model of the technology transfer process since no such model appeared to exist. This overall model describes both the different types of technology transfer activities conducted by NASA, and the relationship between NASA technology development and the technology transfer activities. The model was a significant aid in organizing the many facets of ongoing technology transfer for review.

Once the model had been developed, the major parts of the process were reviewed and findings were documented. To guide future activities to modify/improve the processes, specific metrics were defined which could be used to gauge the effectiveness of the technology transfer activities.

As the review and discussion progressed, there were specific thoughts or principles that the team developed concerning the "ideal" technology transfer process and how to accomplish such a process. The more general of these became the basis for the team's recommendations.

Finally, the recommendations are described. They were drafted to be quite specific to facilitate their implementation.

OUTLINE

Definition of technology transfer

Team scope and relationship to *Technology Integration* Team

Overall model of NASA technology transfer activity

Assessment of technology transfer performance
- Findings on performance
- Metrics for improved performance/ideal process

Basis for recommendations

Recommendations and Summary

DEFINITION OF TECHNOLOGY TRANSFER

The definition for technology transfer adopted by the team is: "The transition of scientific and engineering knowledge from one entity to another for a potentially useful purpose."

The viewpoint implied by this definition is that transfers take place to willing recipients when the recipients think they stand to gain. This definition is somewhat counter to the attitude that technology transfer performance would be better "if only" the recipients were somehow different; e.g., more interested in technology or more risk prone. Rather, the team selected a definition which suggests that the technology must earn its way into use and it will be used when the recipients think they will benefit.

Technology is considered to be an idea, process, or product which has its potential realized in use. It has gone beyond the laboratory or exploration phase and is being used.

To enhance the recipient's ability to use the technology, the recipient must receive sufficient authority to use the technology, e.g., a patent license. The recipient must also receive appropriate protection to use the authority, e.g., the license may be exclusive.

Commercialization is covered by this definition as the specific case of technology transfer where the potentially useful purpose is to exploit the technology for economic gain.

DEFINITION OF TECHNOLOGY TRANSFER

The Transition of Scientific and Engineering Knowledge from One Entity to Another for a Potentially Useful Purpose

Technology is an idea, product, or process which has its potential realized in use

At least the recipient (and usually the provider as well) must think the technology is for a useful purpose

The recipient must receive sufficient authority to use the technology

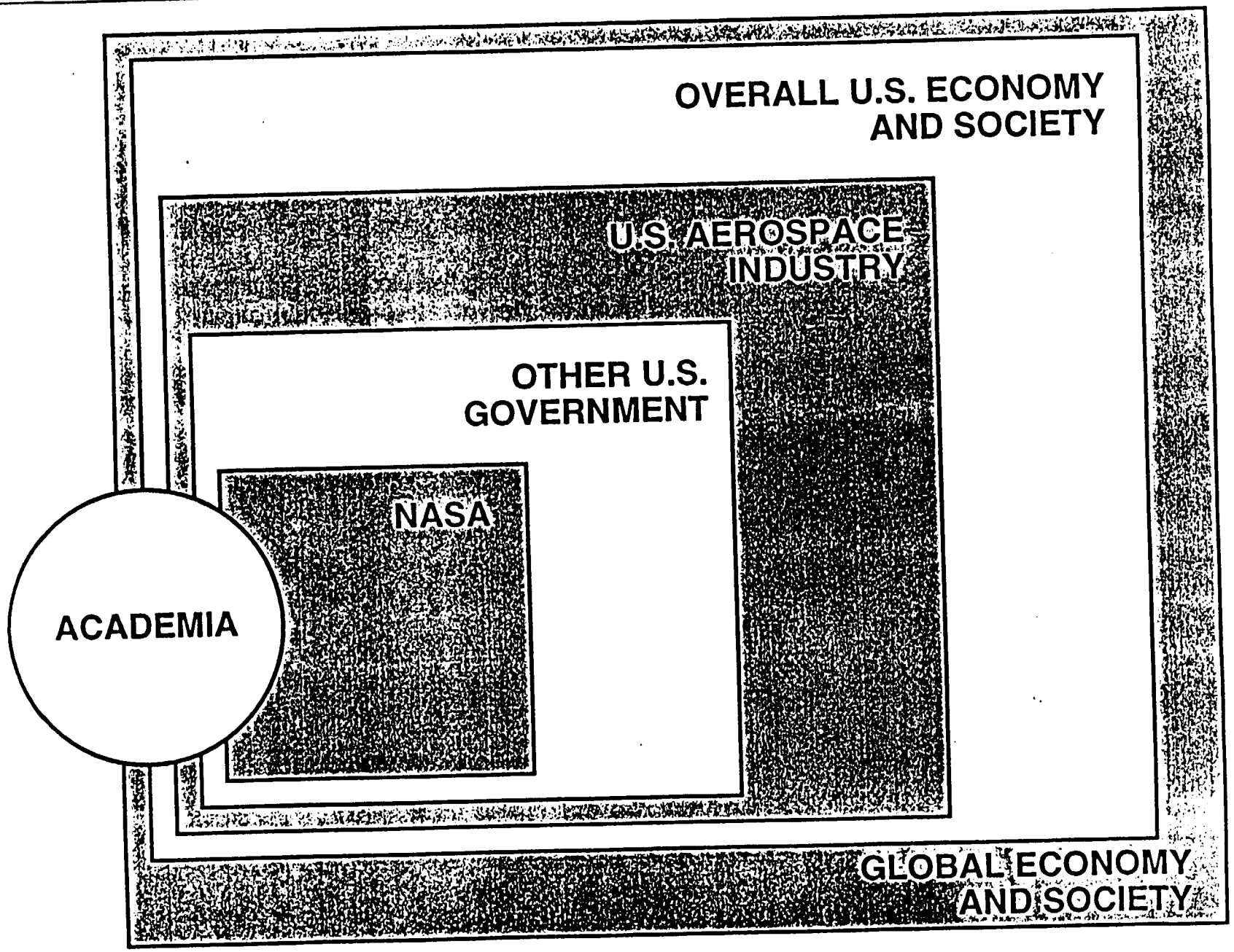
TECHNOLOGY TRANSFER AND SOCIETAL SEGMENTS

One of the first difficulties the team encountered was trying to develop a structure to characterize and classify the many technology transfer activities.

This chart shows some of the elements of that structure, specifically the types of organizations/segments of society involved in technology transfer. This representation was developed at a NASA workshop on "Technology Transfer and the Civil Space Program," organized by John Mankins, OAST, and held at McLean, Virginia, 8/17-19/92

One major point made with this chart is that transfer of technology to industry and the U.S. economy is important, but is not the only technology transfer that is important for NASA to accomplish. NASA also contributes to society, with Mission to Planet Earth as an example.

TECHNOLOGY TRANSFER AND SOCIETAL SEGMENTS



TECHNOLOGY TRANSFER AND INTEGRATION TEAM COORDINATION

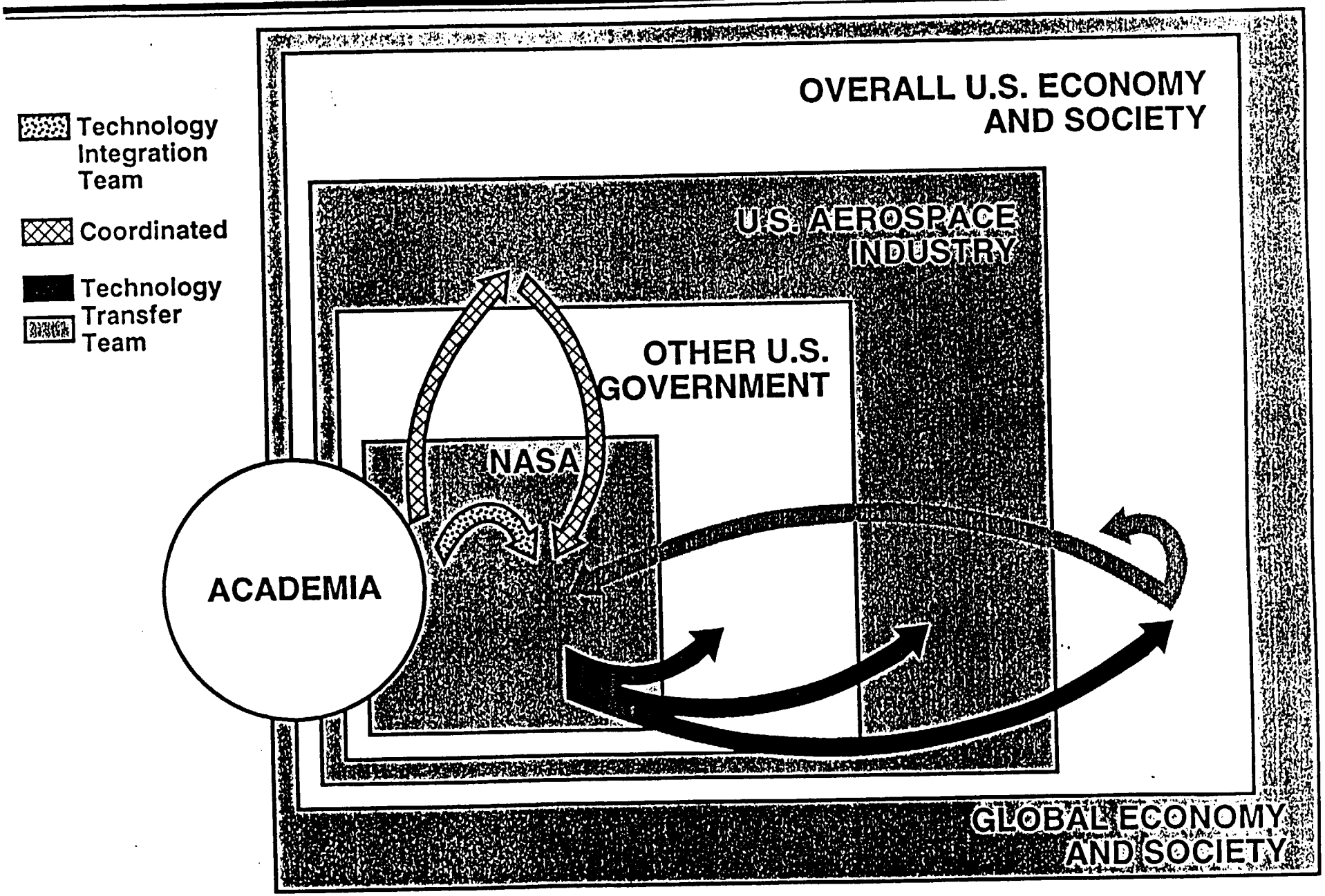
The agreed-upon distinction between the two teams was that the Technology Integration Team, headed by Dr. J. Wayne Littles, MSFC, had the charter to enhance the transfer of technology within NASA. The Technology Transfer Team had the charter to enhance technology transfer from NASA to organizational or societal elements outside NASA.

One significant way technology is transferred within NASA is transfer activity from NASA to a contractor with subsequent use by the contractor of that technology in a NASA mission. This type of transfer was determined by the respective chairmen to be a shared responsibility of both teams. While this transfer mechanism will be specifically reported on by the Technology Integration Team, the Technology Transfer Team briefed the Technology Integration Team on September 29, 1992, on the factors the members of Technology Transfer Team determined in their study which they believed were relevant to the Technology Integration Team.

The main thrust of the Technology Transfer Team was to evaluate and make recommendations for improving the technology transfer from NASA to those outside NASA. This type of technology transfer is shown by the black arrows in figure 6. One non-traditional form that an effective "transfer" might take is shown in the gray arrows. NASA could identify a mission or program technology need which was simultaneously a dual use need of the overall U.S. economy and society. NASA could then foster a firm's or industry's ability to develop such a technology need both to satisfy its own needs as well as the societal needs.

The Technology Transfer Team did not consider either transfers from NASA to the non-U.S. economy, or transfers to or from classified programs. The rationale for this limitation is based on several factors: First, the team believed that the most immediate benefits to NASA's ultimate customer, the U.S. taxpayer, would best be obtained by maximizing the direct transfer of NASA technology into the economy. Second, there are many interrelated mechanisms to enhance the transfer technology to the economy and the team was chosen to cover these many areas. Third, if a specific dedicated effort on inhibiting unwanted technology transfer is to be undertaken, it would seem appropriate to start from a clearer view of the desired or "ideal" technology transfer process and then make the least disruptive required modifications to the "ideal" process to prevent undesired technology transfer.

TECHNOLOGY TRANSFER AND INTEGRATION TEAM COORDINATION



COMMENT

There is a large array of technology transfer processes active within NASA and many organizations involved in these processes. The Technology Transfer Team found that, with the exception of people directly involved in Technology Utilization (TU) programs, awareness of the array of technology transfer activities was almost non-existent. Even some of the people involved in TU were not aware of all the activities. This general lack of awareness was found to be particularly true for the formal infrastructure support for technology transfer (i.e., those activities which have been institutionalized, such as Tech Briefs and other spin-off activities supported by the TU offices). In addition, the technology transfer activities associated with transferring primary NASA mission technology to the target customer are not supported by many formal processes in the infrastructure, and too few people have knowledge about what processes do exist.

Moreover, there was no comprehensive written documentation describing even the existing formal processes. We found that several of the TU professionals we contacted had a great deal of personal knowledge about the activities going on, and could direct us to documentation of several individual activities, but could not point to comprehensive, written descriptions of the TU activities and their relationships.

COMMENT

Except for people within the *Technology Utilization* process, awareness is almost nonexistent of

- the nature of the technology transfer activities
- the extent of technology transfer activities
- the existence of some technology transfer activities

(even the *Technology Utilization* people do not have complete awareness)

There is no written document showing what kinds of technology transfer exist and how they relate

A CLASSIFICATION OF TECHNOLOGY TRANSFER ACTIVITIES

Because of the lack of documentation about technology transfer activities, the team developed a terminology for describing the different components, or categories of technology transfer activities. In this categorization scheme, activities are grouped by two factors:

(1) whether the technology was developed as part of one of NASA's primary missions; and
(2) whether the technology was targeted for a particular customer segment from the beginning of its development.

The factors led the team to identify the following fundamental categories of technology transfer activities.

Primary Targeted Technology Transfer is the transfer of technology from a primary NASA mission (such as aeronautics), where the technology was developed and targeted for a particular customer segment (e.g. an airframe or avionics manufacturer) from its inception. Specific examples of this type of technology transfer includes the aeronautics program, the commercialization of space program, and the Small Business Innovative Research (SBIR) Program.

Secondary Targeted Technology Transfer is transfer of technology that was originally developed as part of a primary NASA mission, but for which an alternative, non-aerospace application was identified, and NASA developed the technology further for that (secondary) application. An example of this is the use of materials technology, originally developed for an aerospace application, being developed further for knee prostheses.

Non-targeted Technology Transfer is transfer of technology that was originally developed as part of a primary NASA mission, reported as new technology and disseminated via NASA Tech Briefs for the public domain. NASA may not know if the technology was used unless the user informs NASA, or a secondary Engineering Applications project results.

The secondary targeted and non-targeted technology transfer activities are often described as the classic "spin-off" or diffusion model of technology transfer, and the latter is the type of activity where formal infrastructure support is strongest.

A CLASSIFICATION OF TECHNOLOGY TRANSFER ACTIVITIES

Primary Targeted Tech Transfer

The technology is part of NASA's primary mission and is developed from the outset with the purpose in mind of transferring it to an identified Aerospace user (includes primary mission technology which has other applications)

e.g., OAST Aero, commercialization of space programs, and SBIR

Secondary Targeted Tech Transfer

Technology originally developed for a NASA mission is extended by NASA to meet the identified needs of a specific user for a non-aerospace application

e.g., use of composite material technology for knee prostheses

Non-Targeted Tech Transfer

Technology which is transferred via "acquisition and dissemination" of information and is used as is, or is extended by user without further NASA assistance

e.g., NASA tech briefs and tech 2000

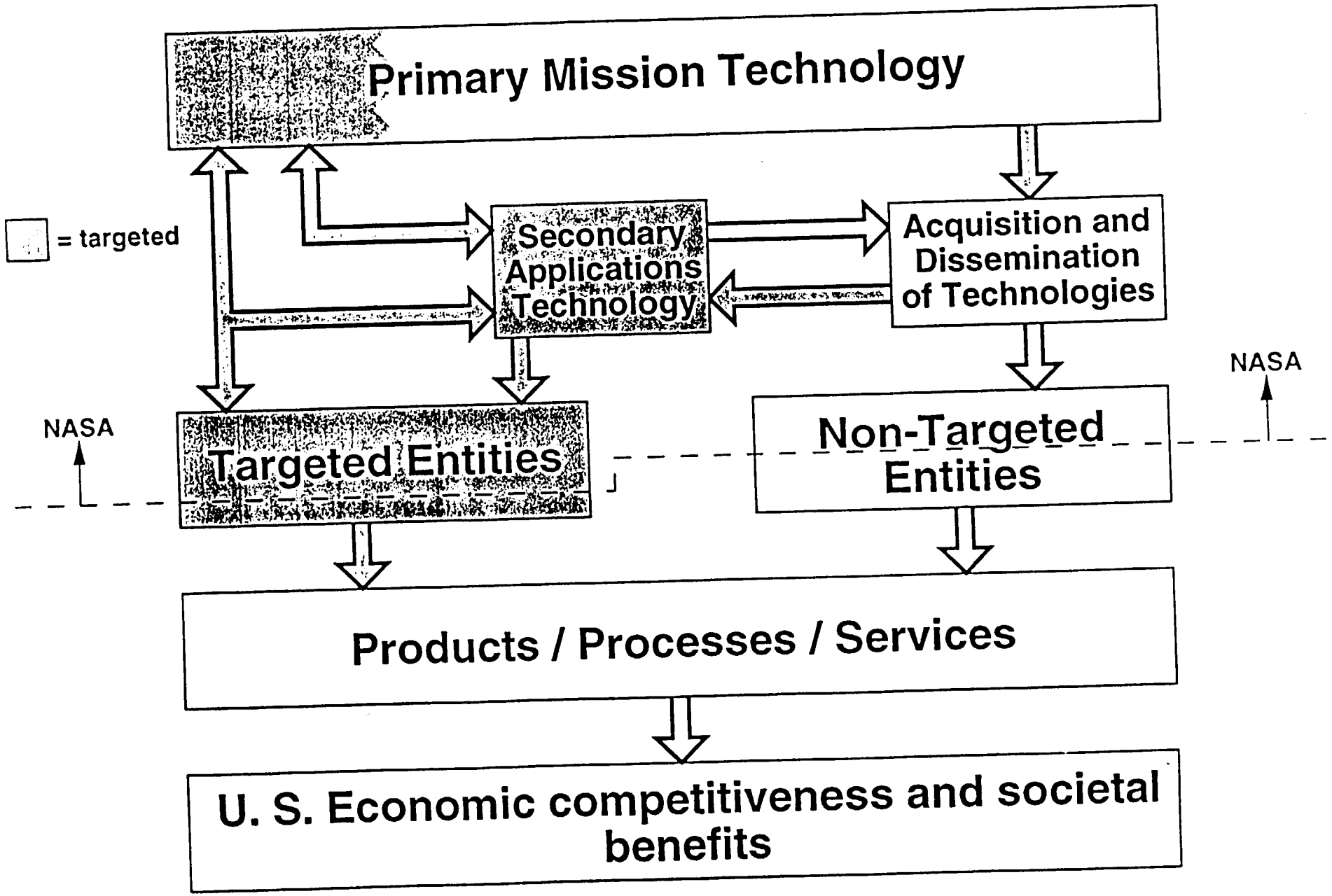
A CONCEPTUAL DIAGRAM OF TECHNOLOGY TRANSFER ACTIVITIES

The relationships among the categories of technology transfer are shown in the facing page. Primary mission technology development refers to technology developed with NASA funds for primary NASA missions, including in-house and contracted technology development. This activity would also include the situation discussed on the page facing vu graph 6 where NASA fosters development of a capability to simultaneously serve its own needs as well as "dual-use" societal needs. Where NASA has a choice of technologies which satisfy its mission needs it should elect, where practical, that technology which also best serves U.S. economic and societal needs.

The arrows in the figure represent the technology transfer activities, with the direction showing that the technology goes to targeted entities or recipients, further development of the technology for non-aerospace purposes, and/or dissemination of information about the technology for non-targeted recipients. The targeted and non-targeted entities use the technology for products, processes, or services contributing to U.S. economic competitiveness and/or societal benefits.

The shaded arrows represent targeted technology transfer activities, and the unshaded arrows are non-targeted activities. The arrow going from primary mission technology is partly shaded to make clear that both targeted and non-targeted technology is acquired and disseminated. A typical path for primary targeted technology transfer is for the technology to transfer directly to the recipient. Secondary technology transfer can occur along more than one path: either directly from primary mission technology development, or through broad information dissemination. Non-targeted technology transfer usually takes place through dissemination of information via the TU activities.

A CONCEPTUAL DIAGRAM OF TECHNOLOGY TRANSFER ACTIVITIES



SUMMARY OF FINDINGS

The following sections present the findings of the team in detail, but they can be summarized with the following two statements:

1. **Significant, continuing improvements must be made in NASA's technology transfer performance for NASA to best serve the country.** We found that transfer of NASA technology occurs, but not as often or as extensively as it could or should. A recent survey of aeronautics customers by the Gallup organization found room for significant improvements. As an example of additional evidence to support the team's position, NASA licensed only 19 patents for the entire Agency over the last two years. The NASA research and development budget was about $6 billion in FY 91. From this funding, 1,947 New Technology Reports (NTR) (required reports by NASA employees, contractors, and grantees) resulted. This is an average of less than one NTR per $3M in R&D funds. There are a number of technology transfer successes; nevertheless, these and other statistics suggest that much better performance is possible.

2. **NASA's culture must change to achieve the required continuous improvement in technology transfer.** Part of the reason that the full potential of transferring NASA technology does not happen is because the culture does not support and encourage it to the extent that it could or should. The team found that an attitude of "it's not my job" was too prevalent.

In the following sections, we first describe the findings that apply to all technology transfer activities. Then, we present the findings particular to each of the three specific categories (primary targeted, secondary targeted, and non-targeted) of technology transfer activity.

SUMMARY OF FINDINGS

Significant, continuing improvements must be made in NASA's technology transfer performance for NASA to best serve the country

NASA's culture must change to achieve the required continuous improvement in technology transfer

WHAT WE FOUND

First and foremost, NASA is accountable to transfer its technology. From NASA's origins in NACA through the Space Act which created the Agency, and including recent legislation it has been clear that technology transfer is a fundamental part of the NASA mission.

NASA does have a good reputation for technology transfer. The Agency is looked upon as a good example, and has been directed by Congress to foster other technology transfer activities, including some involving non-NASA technology. This reputation is based primarily on the transfer of non-targeted technology and aeronautics technology. To much of the public, NASA's technology transfer reputation is based on some famous examples, including Velcro, Tang, and Teflon. Contrary to popular belief, NASA created none of these "famous three" products. NASA did use them in a way that publicized or popularized them, and it seems clear that association with NASA was used to enhance their credibility, but NASA cannot take credit for creating them. Of course, there have been many successful spin-offs, especially in the medical field. In aeronautics, NASA's reputation is based on a number of NASA technologies being used in the design of current aircraft, such as super-critical wings, area rule, and glass cockpits, just to name a few. This is best known within the aerospace community, however, and although lists of many of these successful transfers exist, consistent statistics have not been kept.

The team concluded that there have not been very many technology transfer successes compared to the potential, and that past successes have been largely anecdotal. Depending on how one defines "R&D," a third to a half of NASA's budget is spent on this category, with the remainder going to space operations. Out of this investment in R&D, roughly one New Technology Report (NTR) is generated for every $3 million, and only a fraction of NTR's eventually result in a transfer of technology. This is not a definitive measure of technology transfer, and undoubtedly many transfers occur that were not reported in NTR's, but it is does indicate that much technology is being generated without necessarily being transferred, or at least as being documented as being transferred.

The team found that distinct, non-integrated technology transfer activities and processes are being pursued within the Agency. As just one example, Space Station Freedom has its own Technology Utilization Officer, whose efforts are not integrated with other Technology Utilization activities.

WHAT WE FOUND

NASA is accountable to transfer its technology

NASA's good reputation is based primarily on non-targeted technology transfer and Aeronautics

There have not been many successes compared to the potential

Past successes have been largely anecdotal

Technology transfer processes are non-integrated, undocumented, and too slow

WHAT WE FOUND (continued)

As stated earlier, the team found no comprehensive written documentation describing even the existing formal processes. Several of the TU professionals we contacted had a great deal of personal knowledge about the activities going on, and could direct the team to documentation of several individual activities, but could not point to comprehensive, written descriptions of the TU activities. There was no documentation at all of primary technology transfer processes.

Current processes within NASA are too slow to meet industry's needs. For example, at one research center, it requires approximately nine months to one year to get a technical paper published. As other examples, Tech Briefs take (on average) approximately 18 months to be published, and patents usually require 18-24 months from disclosure to filing.

WHAT WE FOUND------WHY IT WAS THERE TO BE FOUND

NASA is hampered in its technology transfer activities by the lack of a clear statement of policy that technology transfer is a fundamental mission of the Agency and that secondary targeted and non-targeted transfers are fully valued, important NASA activities. This point is discussed further on the next slide.

Unfortunately, all too often, NASA employees, managers, contractors, and grantees do not feel technology transfer is part of their job. Researchers are more inclined to view their job as technology development, and that the effort required to transfer technology is time and resources taken away from their "real" job. NASA management has fostered this view, first by not actively encouraging and rewarding technology transfer activities, and second by discouraging some types of technology transfer activities, especially secondary targeted activities. Other reasons for NASA employees taking the view are expanded in findings described below.

As has been stated previously, statistics and metrics of success have not been routinely kept and used for management of technology transfer activities. Many statistics have been *recorded*, such as number of patents and number of papers published, but these statistics have not been correlated to customer use of NASA technology nor have they been used to manage technology transfer activities.

In addition to being too slow, NASA has been criticized for not taking technology far enough to reduce technical risk for industry. One reason that NASA has not taken technology further than it has is because applications activities tend to be quite expensive; thus, in light of limited resources, such efforts have often not been pursued.

The team did find that NASA is not fundamentally limited by existing legislation. For example, the Space Act calls for "widest possible dissemination" of the technology, and the Stevenson-Wydler Act of 1980 mandates that "federal labs transfer federally-originated technology to state and local governments and to the private sector." Recent legislation also creates increased flexibility in cooperative working arrangements available to NASA.

Based on these findings, the team concluded that technology transfer processes within NASA are ripe for continuous improvement, especially the principles of customer orientation and use of external measures of success.

WHAT WE FOUND

WHY WHAT WE FOUND WAS THERE TO BE FOUND

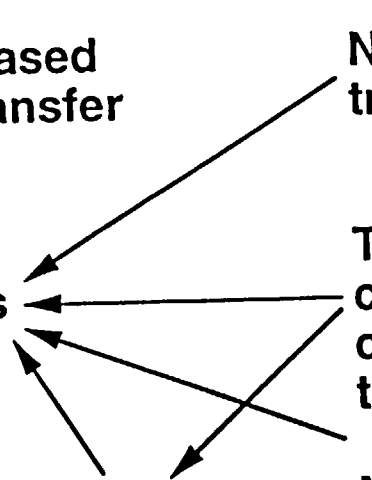
NASA is accountable to transfer technology

NASA has a good reputation based on non-targeted technology transfer and aeronautics

There have not been many technology transfer successes compared to the potential

Past successes are largely anecdotal

Technology transfer processes are non-integrated, undocumented, and too slow



No clear NASA policy for technology transfer

Too often, employees, managers, contractors, and universities don't consider technology transfer part of their job

No systematic metrics/statistics used for decisions

Technology transfer processes are non-integrated, undocumented, and too slow

Application studies are expensive - causes gap between idea and application

We are not fundamentally limited by legislation we are limited by our will

A POINT OF LEGISLATION AND POLICY

The Stevenson-Wydler Act is one of several pieces of legislation* passed in the 1980's. One consequence of that legislation is that other agencies, especially the Department of Energy (DOE), have developed aggressive policies with respect to technology transfer.

In addition, other factors, such as increased emphasis on improving U.S. economic competitiveness, are increasingly causing NASA to be held accountable for its performance in technology transfer.

In the absence of a clear, aggressive overall Agency technology transfer policy, the legal staff is in effect establishing the policy through their interpretation of the use of the Space Act for proposed innovative technology transfer programs. This is an awkward position for them to be in, and we believe it has led them to interpret the Space Act in a very conservative manner. A few experiences in the innovative use of the Act have taken considerable time and have been met with reluctance.

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*Examples:

Stevenson-Wydler Technology Innovation Act of 1980 (PL 96-480)
Required Federal Laboratories to take an active role in technical cooperation

Bayh-Dole Act of 1980 (PL 96-517)
Authorized granting exclusive and partially exclusive licenses

Cooperative Research Act of 1984 (PL 98-462)
Permitted industry consortia (e.g., SEMATECH, MCC)

Federal Technology Transfer Act of 1986 (PL 99-502)
Made technology transfer a responsibility of all federal lab scientists

A POINT ON LEGISLATION AND POLICY

Technology transfer legislation passed in 1980's has resulted in aggressive policies in sister agencies

NASA is being held accountable for its performance under the standards being set through recent and emerging technology transfer legislation

In the absence of an aggressive overall agency technology transfer policy, legal staff is often put in an awkward position to interpret the use of the Space Act for approving innovative technology transfer programs

A few experiences in the innovative use of the Space Act have taken considerable time and been met with reluctance

FINDINGS: PRIMARY TARGETED TECHNOLOGY TRANSFER

Overall, NASA's efforts in transferring technology from primary mission activities (e.g., aeronautics, Business Innovative Research (SBIR) program, and Centers for Commercial Development of Space (C relatively good.

In aeronautics, a positive relationship does exist with industry. A strong (but anecdotal) record of accomplishment exists. There is a list of approximately 80 NASA-generated technologies used in the aircraft industry, including famous items such as the area rule, supercritical wing, winglets, glass cockpit, and many others. However, there is significant room for improvement even in light of these successes. A recent Gallup poll showed that the aeronautics industry felt that there was significant room for improvement.

The Small Business Innovative Research (SBIR) program has two objectives: (1) provide a venue for new, innovative ideas that can help NASA meet mission objectives or solve problems, and (2) to commercialize the ideas. The first of these objectives is being met. The second, however, does not appear to be met. NASA's SBIR awards result in an average of $161K in sales for the company per SBIR project - this is the lowest in the government.

The CCDS's are generally agreed to be active, technically self sufficient, and fulfilling their major mission objectives. In fact, they can be characterized as "little NACA's." One lack identified by the team was that the field centers relationships with the CCDS's are limited.

In aeronautics, the team identified an issue with respect to an imbalance in customer orientation between researchers and management. All too often, researchers viewed technology transfer as writing a report on the results of the research after it was completed. The customer is expected to pick up the report and read it to get the technology. Although this view is not universally held by all researchers, it is prevalent enough to be a concern. This view is strengthened in the researchers' perceptions by the emphasis placed on number of reports in getting promotions. On the other hand, higher-level management has a strong customer-orientation -- sometimes considered to be too strong, resulting in a view that NASA does not add enough of its own value to the customers' input. One could speculate whether the imbalance is the result of managers overcompensating for the researchers' views, or the opposite. Regardless of the reason, some polarization does appear to exist.

FINDINGS: PRIMARY TARGETED TECHNOLOGY TRANSFER

Overall technology transfer performance in Aeronautics is "OK"

- Positive relationship with industry
- Strong (but anecdotal) record of accomplishment
- Still, significant room for improvement

The SBIR Program's objective to provide a venue for new ideas is being fulfilled, but its objective to commercialize these ideas is not.

The CCDS's are active, self-sufficient technically, and accomplishing their primary mission objectives, but their relationships with the field centers are limited.

Imbalance exists in customer orientation between management and researchers.

Too often technology transfer is viewed as happening at end of development process.

Researchers perceive little direct connection between technology transfer and reward. Reporting results is considered to be the culmination of research and the source of rewards.

Little/no direct infrastructure support for primary targeted technology transfer.

No systematic measurements of activity or effectiveness in primary technology transfer.

FINDINGS: PRIMARY TARGETED TECHNOLOGY TRANSFER (continued)

The point was made above that researchers often viewed technology transfer as writing a report on the research results after it was completed. This is representative of a common view that technology transfer occurs at the end of the technology development process. Feedback from customers and examining successful cases suggest, however, that technology transfer is best done as part of the technology development process.

Researchers perceive little direct connection between technology transfer and rewards. Writing technical reports is considered to be the culmination of the research and the source of rewards, especially promotions. They are apparently unaware of the positive effect of technology transfer activities (especially) in high-level (GS-14/15) promotions. With respect to other types of awards, a researcher receives $150 for a Tech Brief. This is considered to be too small to have any real motivational influence.

There is little/no infrastructure support to help researchers transfer technology. For example, most of the TU activities (which have the most infrastructure support) are not involved with primary targeted technology transfer. If a conscientious researcher proactively attempts to transfer technology, roadblocks are often encountered within the TU infrastructure. For example, filing a patent can be a time-consuming process that can require much effort by the researcher. Another example is NMI-2210.2B, which restricts distribution of any software except through COSMIC, another time-consuming process which appears to have little benefit for the researcher.

It was mentioned earlier that statistics/metrics are not systematically kept and used for management of technology transfer. The team identified that metrics in general, and especially for primary targeted technology transfer, can be usefully thought of as belonging to two different categories: **activity** and **effectiveness** metrics. Activity metrics are measures of the activities that are underway, and reflect the process of technology transfer. Examples of activity metrics are papers published or phone calls made to customers. Effectiveness metrics are measures of how well the goal of accomplishing actual transfers is being attained and thus are measures of the **product** of technology transfer. No systematic measurements of activity or effectiveness are currently kept for primary targeted technology transfer.

The points made in last few paragraphs help explain several of the reasons why many researchers do not feel that technology transfer is part of their jobs.

METRICS - PRIMARY TARGETED TECHNOLOGY TRANSFER

Often, when one sees or develops metrics for R&D, the result is a long list of items such as, papers published, visits made, phone calls answered, etc., with minimal structure. This team set out to develop a structured set of metrics which would be more useful in managing the technology transfer process. A set of activity and effectiveness metrics were developed for each of the three types of technology transfer as described below.

Different metrics could be measured at different points in the technology transfer process. For example, phone calls made could be measured before the transfer took place, whereas number of citations (number of times a NASA-authored publication was cited by other technical authors) is a post-transfer measure. The metrics were organized according to the point in the technology transfer process (preparation for technology transfer, the transfer, post transfer) during which the measurement could be made, as shown in the facing page chart.

Not all metrics need to be assessed. We also identified those metrics which were most important in the following respect: if we took these measures (shown in the boxes in the chart), we would not need to measure the others, since the non-boxed measures contribute to the boxed measures. The team felt that efficiency metrics (as described in the text facing page 14) were better than activity metrics. Activity metrics were felt to be better than no metrics if they had a strong causative correlation with an effectiveness metric.

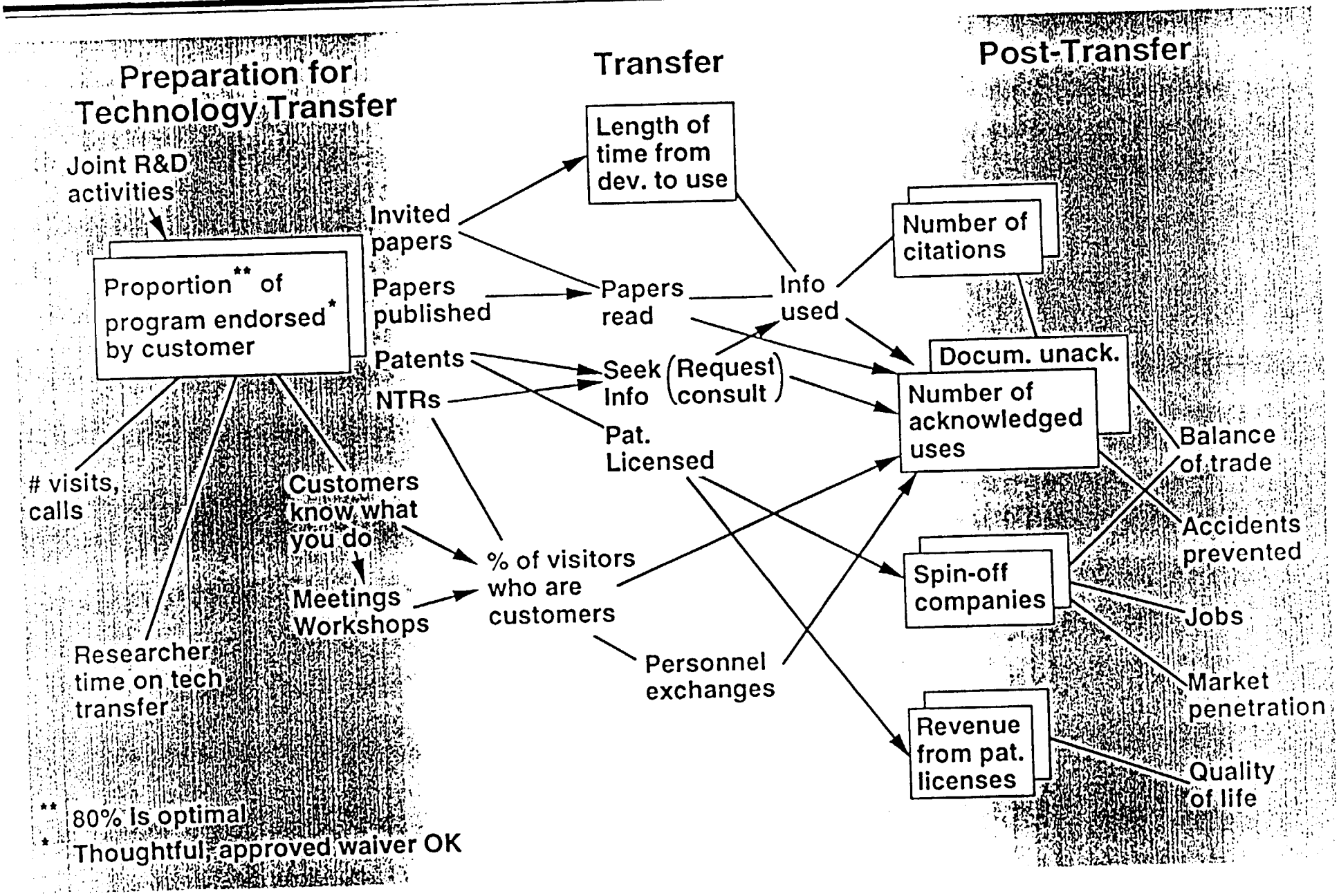
Metrics for primary targeted technology transfer - The team identified six metrics that constitute a small but sufficient set for this category of technology transfer activities:

(1) proportion of program endorsed by the customer,
(2) length of time from development to use,
(3) number of citations,
(4) number of acknowledged uses,
(5) number of spin-off companies, and
(6) revenue from patent licenses.

The first two are activity metrics and the remainder are effectiveness metrics.

(1) In the preparation or pre-transfer stage, we concluded that the proportion of program endorsed by the customer is important to measure, because customer endorsement implies that a technology transfer relationship exists that is more likely to succeed. The optimal proportion may differ for different technology areas, but it should not be 100%, since that would probably result in a research program which would be too

PRIMARY TARGETED TECHNOLOGY TRANSFER METRICS



near term. While the ideal % can vary it probably should be more than 50%. Holding at something less than 100% allows the customers' needs to be met while not precluding "Base R&D" activities which will form the basis for future customer-endorsed programs. We estimate that 80% is a good target, with "thoughtful waivers" being acceptable. That is, a program plan may be judged by the researcher and management as useful to the customer needs, even if the customer chooses not to endorse it. Such waivers are considered to be part of the 80%, with the other 20% consisting of research that need not have a customer or a customer's endorsement. We do recommend that the endorsement be in writing. While this metric is an activity metric, it is included since metrics (3) - (6) suggested in the sequel occur when a transfer has been accomplished The "endorsement" metric is included since it is a present indicator of future successful technology transfers.

(2) In the transfer phase of the process, the key metric is the length of time from development to its transfer for use by a targeted customer. NASA has consistently been criticized for the timeliness of it programs. Hence, improving this metric can enhance the relationship that NASA has with its customers, especially in industry. This represents a measure of the efficiency of the technology transfer activity.

(3) - (6) The next four metrics assess the effectiveness of the transfer process by evaluating the actual use of the technology. Citations indicate that someone has read a publication NASA produced and used the information in some way. The number of acknowledged uses indicates letters written or some other documentation exists that shows that NASA technology was used for some useful (to the customer) purpose. Personnel exchanges are very effective as a means of transferring technology. Rather than making a whole separate metric for personnel exchanges, they can be assumed to be a type of "acknowledged use" and count as a very important contribution in that category. The existence of spin-off companies shows that NASA technology was taken and used to create some product, as does revenue from patent licenses. We recognize that for each of these measures, there is a corresponding number of unacknowledged uses of the technology, but we cannot measure those. Each of these four metrics indicate a contribution to overall economic and societal benefits (such as balance of trade, accidents prevented, and jobs created), but these benefits are extremely difficult to measure.

FINDINGS: SECONDARY TARGETED

Many developers of NASA technology have had little or no direct interest in non-aerospace applications, and are not aware (or may not agree) that doing this type of technology development is part of NASA's charter. The general perception is that R&D aimed at non-aerospace applications is not important. One indication of this low priority is that the budget for this activity is only $5M in FY 92 (and $0 in FY 93) for the entire Agency (out of a $15B budget). The burden for implementing this type of activity is on the TU officer, with little commitment from the research organizations. Often the research organizations consider themselves to be already spread too thin to take on additional, non-aerospace applications. Researchers have been actively discouraged from doing this type of technology development and transfer, and too often, are given little recognition for contributions that are made.

The process for initiating such activities is cumbersome and often slow. It can take up to a year or more to get an activity underway under the Engineering Applications Program.

Six NASA Regional Technology Transfer Centers (RTTC) have recently been formed to make this activity more proactive. Their major objectives are market identification and brokering technology transfer activities. A key factor to their success is knowing the strengths and weaknesses of their region.

After examining examples of successful secondary targeted technology transfer, such as the knee prostheses development, the team concluded that such activities offer significant potential for improving public support as well as an increased return on investment since the technology had a dual use. Raising awareness of such applications gives NASA a very positive image to the public.

FINDINGS: SECONDARY TARGETED

Generally, the perception in NASA is that R&D aimed at non-aerospace industry is not important

- Few resources - people/funds
- Burden is on TU officer - little commitment from primary research organizations
- Management gives little recognition for contributions

Process is cumbersome, inconsistent, and often slow

Regional technology transfer centers (newly formed) have the potential to play an important role in identifying markets

Secondary targeted transfers offer significant potential for transferring technology in a way which improves public support

METRICS FOR SECONDARY TECHNOLOGY TRANSFER

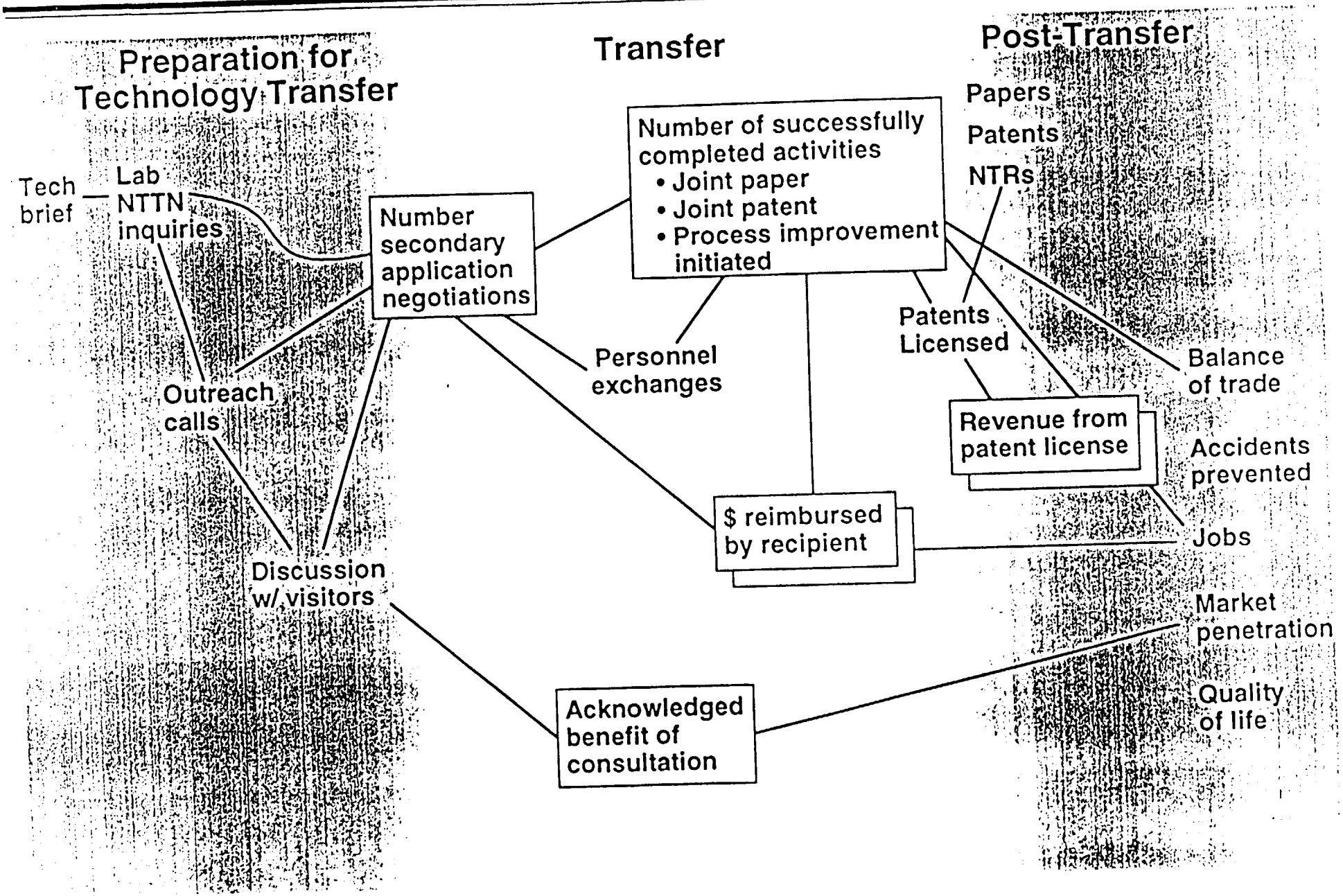
As with primary targeted technology transfer, the team identified activity and effectiveness metrics, and their relationship to the different phases of the technology transfer process. In this case, many of the boxed measures are taken while the transfer is taking place.

A small but sufficient set of metrics suggested for secondary targeted technology transfer are:

(1) Number of secondary targeted application negotiations,
(2) number of successfully completed activities as evidenced by a joint paper, joint patent, or process improvement initiated,
(3) dollars reimbursed by recipient,
(4) acknowledged benefit of consultation, and
(5) revenue from patent licenses.

The first of these is an activity metric, while the remainder are effectiveness metrics, since each one is evidence that the technology is being used in secondary applications.

METRICS FOR SECONDARY TARGETED



FINDINGS: NON-TARGETED

The non-targeted technology transfer activities deserve much of the credit for the success NASA has had in its "spin-offs", especially (but not exclusively) in transfers to medical applications. Just a few are:

- Insulin pumps for diabetics
- Rechargeable cardiac pacemaker
- Image processing for analysis of NMR, CT scan, etc.
- Riblets on the America's Cup - Stars and Stripes
- Lens coating for sunglasses

However, this apparent success is only a small portion of the potential, because the process for acquiring and disseminating information about the technology is cumbersome and too slow for today's technology needs. The dissemination of information about NASA technology for non-targeted transfer happens mainly via Tech Briefs. Two aspects of Tech Briefs that contribute to the slowness and cumbersome nature of the process are (1) getting the information from the technology developers, and (2) distributing the information. The major mechanism for getting information about new technology comes from NTR's (New Technology Reports). The number of NTR's is lower than it could be, primarily because there is little or no incentive for the technology developers to report it, and they are unaware of how and why the NTR's are used. In order to distribute the information, it must be put into the appropriate form for Tech Briefs, a process which currently takes 18-24 months.

Most TU offices are minimally staffed, and cannot provide any greater support for all technology transfer functions. In fact, the team recognized that TU offices have been operating under the generally understood policy that they are not to interfere with the primary NASA mission while supporting the secondary and non-targeted types of technology transfer activities. As a consequence of this policy, TU activities are not given a great deal of priority, and "career paths for technology transfer people are very limited: the best and brightest can get a better deal." This is a quote from a senior TU official, who also said rather wistfully that "Someday I'd like to work for NASA." It requires a very dedicated person to actively and enthusiastically pursue the types of technology transfer activities performed by the TU offices under such circumstances. Many researchers don't even know who the TU officer is at their center.

The six RTTC's were intended to proactively pursue non-targeted types of technology transfer activities, but their relationships with the NASA centers are inconsistent and unclear. Since the NASA centers are the sources of technology, these relationships should be strengthened consistently.

FINDINGS: NON-TARGETED

Gets most of the credit for the historical transfer "spinoff " successes

Process is cumbersome, too slow for today's technology needs

- New technology reports (NTR's) have to be "pulled" - minimal incentives
- Most TU center offices are minimally staffed - cannot provide support for all technology transfer functions

"Career paths for technology transfer people are very limited: best and brightest can get a better deal"

Relationship of Regional Technology Transfer Centers with NASA centers is growing but inconsistent

The role of and value added by the National Technology Transfer Center is not clear

FINDINGS: NON-TARGETED (continued)

The *stated* role of the National Technology Transfer Center (NTTC) is to serve as a federal clearinghouse for new technology. However, the team could not identify the value added of the NTTC. While it is intended to be a national resource, no other federal lab contributes to its existence.

METRICS FOR NON-TARGETED

As with the other types of technology transfer, the team identified activity and effectiveness metrics for non-targeted technology transfer activities. We also identified the "boxed" metrics, which include:

(1) Requests for Technical Support Packages (TSP's). These are the packages of information that are provided to someone who reads a Tech Brief, becomes interested in the technology described, and asks NASA for more information.

(2) Number of secondary targeted requests. This is the number of requests for secondary targeted technology development activities that are generated as a result of broad dissemination of information. This particular metric ties together the non-targeted and secondary targeted technology transfer activities by defining one measure of success of the non-targeted activities to be the number of secondary targeted requests which result from broad information dissemination.

(3) Number of Tech Briefs & TSP's used. This is one indication of the information/technology that NASA disseminated actually being used.

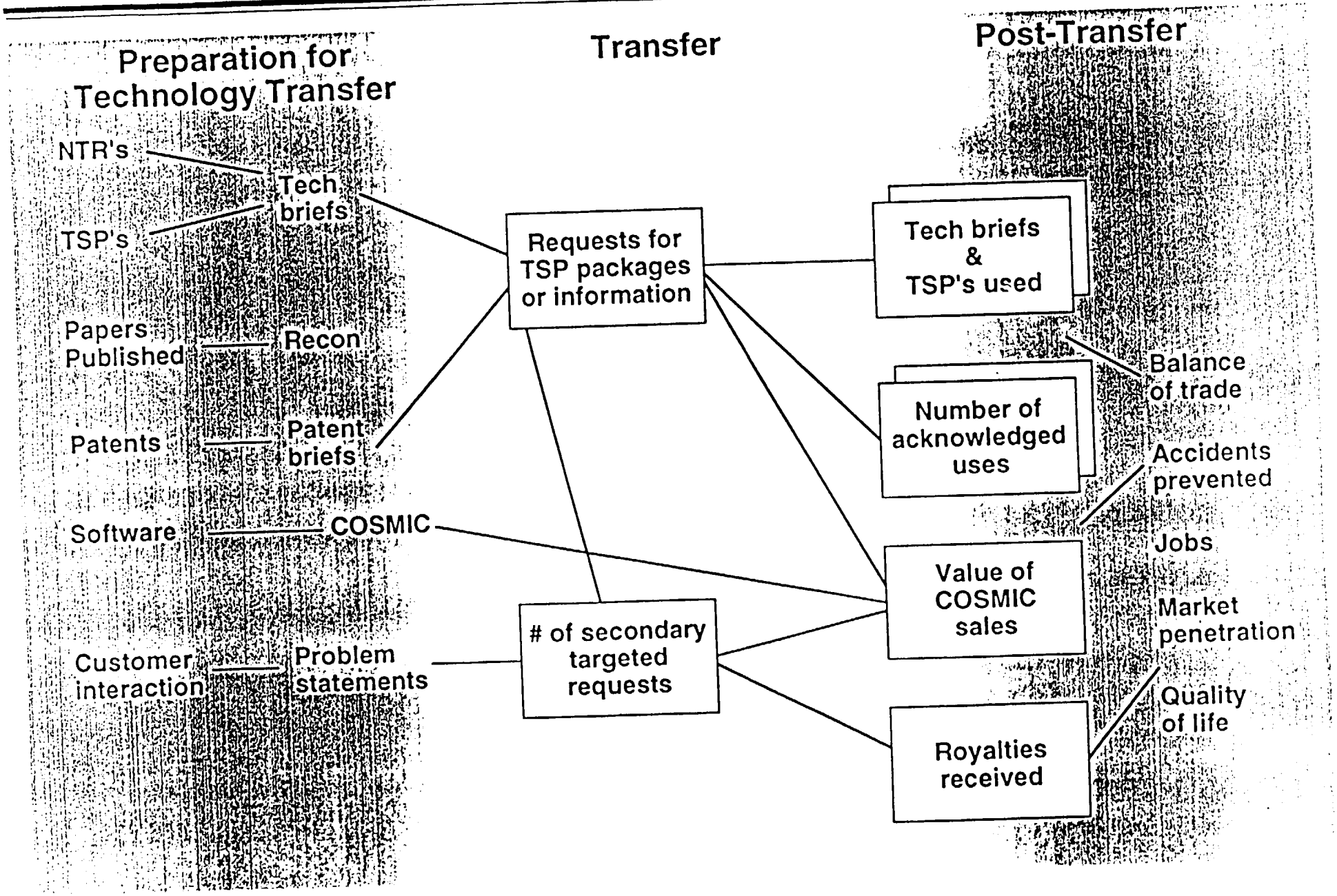
(4) Number of acknowledged uses. This represents other acknowledged uses of the technology, as documented in a letter or some other form.

(5) Value of COSMIC sales. This measures how much money has been generated by software purchased from COSMIC, NASA's software dissemination organization. Since all software is currently required to go through COSMIC, the value of sales would reflect not only non-targeted uses of the software, but primary targeted uses as well. This still is better than not measuring the sales. Moreover, in the recommendations, the team calls for a process action team to review COSMIC and it may well be that other means are found for handling primary targeted software transfers.

(6) Royalties received. This is revenue from patent licenses.

(1) and (2) are activity metrics, and (3)-(6) are effectiveness metrics.

METRICS FOR NON-TARGETED



BASIS FOR RECOMMENDATIONS

The basis for the recommendations described on the next two charts represent the conclusions that the team came to relative to the nature and effectiveness of technology transfer activities. Indeed, they describe the characteristics of the ideal process for technology transfer, as determined by the team based on assessing NASA's and others successes and failures, especially in today's technology transfer environment.

NASA is accountable to transfer its special capabilities and technology. The Agency is mandated to take positive action to place the results of its R&D into the hands of those who can apply it to public and private benefit, particularly in U.S. industry. Thus it is an important mission of the Agency, which is adequately established in the Space Act and subsequent legislation.

Success in technology transfer requires deliberate, dedicated effort. This reinforces the point made earlier that NASA must initiate and proactively pursue technology transfer activities. The "spin-off" model of technology transfer is inefficient, and doesn't apply to primary targeted technology transfer.

Technology transfer occurs mainly in the context of an appropriate person-to-person relationship between providers and recipients. The success cases in primary and secondary targeted technology transfer almost always involved one-on-one or small group interactions between technology developer and technology customer. In the Gallup poll, NASA's aeronautics customer identified "informal discussions" as the most effective means by which technology gets transferred.

In the past, NASA has been viewed as pushing its technology. Experience suggests that technology transfer is most successful when recipients *want* technology for their needs. This is sometimes referred to as market pull. *Effective, proactive outreach* creates this *desire*. Thus a marketing model for technology transfer has great potential for success. In other words, proactive outreach converts technology push to market pull. The team concluded that a passive diffusion model leaves too much to chance.

BASIS FOR RECOMMENDATIONS (Cont.)

Technology transfer is inseparable from the technology development process. Technology can (and should) be transferred at every stage of technology development. NASA's customers have stated in the past that they do not want to wait until technology is completely developed before they get involved in its transfer. Their belief is that early involvement gives them better understanding of the technology and it applicability to their needs. Further, just as research methods differ from technology to technology, technology transfer methods will differ for different technologies and must be tailored accordingly.

The influence of customer interests in NASA R&D goals is a vital indicator of potential success. Having customer interests reflected in the R&D goals shows that the provider and potential recipient are communicating, at least about customer needs. This represents early recipient involvement in the technology development process, and shows a technology transfer relationship that is more likely to succeed.

For technology transfer process management and improvement, effectiveness metrics are better that activity metrics. Because effectiveness metrics usually cannot be measured until the technology development is completed (and sometimes long after that), **activity metrics having a strong, causative influence on effectiveness are useful.**

The technology transfer process should be conducted so that employees' interests are benefited (ideally) and protected (at a minimum). One cannot expect employees to pursue activities where their interests are compromised. Yet that is currently the case with joint versus individual patent licensing, to mention one example. The rules that now exist discourage early joint activity, because the employee will lose royalties by doing so.

Based on the points made above, the team concluded that technology transfer is best achieved as a market-oriented, using proactive outreach to create market pull, technically conducted, based on technical interactions between mutually respected providers and recipients, legally supported activity, the role of the legal offices should be supportive, not directive.

BASIS FOR RECOMMENDATIONS

1. **NASA is accountable to transfer its special capabilities and technology.**
   This is an important mission of the agency.

2. **Success in technology transfer requires deliberate dedicated effort.**
   Thus NASA must initiate technology transfer activities.

3. **Technology transfer occurs mainly in the context of an appropriate person-to-person relationship between the providers and recipients.**

4. **Experience suggests that technology transfer is most successful when recipients *want* technology for their needs. *Effective, proactive outreach* creates this *desire.* Thus a marketing model for technology transfer has greater potential for success.**
   A passive diffusion model leaves much to chance.

BASIS FOR RECOMMENDATIONS (Cont.)

Technology transfer is inseparable from the technology development process. Technology can (and should) be transferred at every stage of technology development. NASA's customers have stated in the past that they do not want to wait until technology is completely developed before they get involved in its transfer. Their belief is that early involvement gives them better understanding of the technology and it applicability to their needs. Further, just as research methods differ from technology to technology, technology transfer methods will differ for different technologies and must be tailored accordingly.

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Based on the points made above, the team concluded that **technology transfer is best achieved as a market-oriented,** using proactive outreach to create market pull, **technically conducted,** based on technical interactions between mutually respected providers and recipients, **legally supported activity,** the role of the legal offices should be supportive, not directive.

BASIS FOR RECOMMENDATIONS (con't)

5. **Technology transfer is inseparable from the technology development process.**

6. **The influence of customer interests on NASA R&D goals is a vital indicator of potential success.**
   This influence shows early recipient involvement, and shows that a technology transfer relationship exists that is more likely to succeed.

7. **For technology transfer process management and improvement, effectiveness metrics are better than activity metrics. Activity metrics having strong, causative influence on effectiveness are useful.**

8. **The technology transfer process should be conducted such that employees' interests are benefited (ideally) and protected (at minimum).**

TECHNOLOGY TRANSFER IS BEST ACHIEVED AS A MARKET-ORIENTED, TECHNICALLY CONDUCTED, LEGALLY SUPPORTED ACTIVITY

WHY WHAT WE FOUND WAS THERE---WHAT WE SUGGEST DOING ABOUT IT

A set of ten recommendations have been framed to enable NASA to significantly improve its performance in technology transfer and enhance the Agency's performance as a national leader in transferring its technology to benefit society and enhance national competitiveness. The recommendations are designed to change the culture of the Agency to ensure that employees feel that technology transfer is a fundamental part of the Agency's mission and their own job. At the same time, two recommendations are made to protect the employee's interests in intellectual property rights while establishing methods to motivate the employees to accomplish technology transfers and to assess, promote and reward them at least in part based on their technology transfer performance.

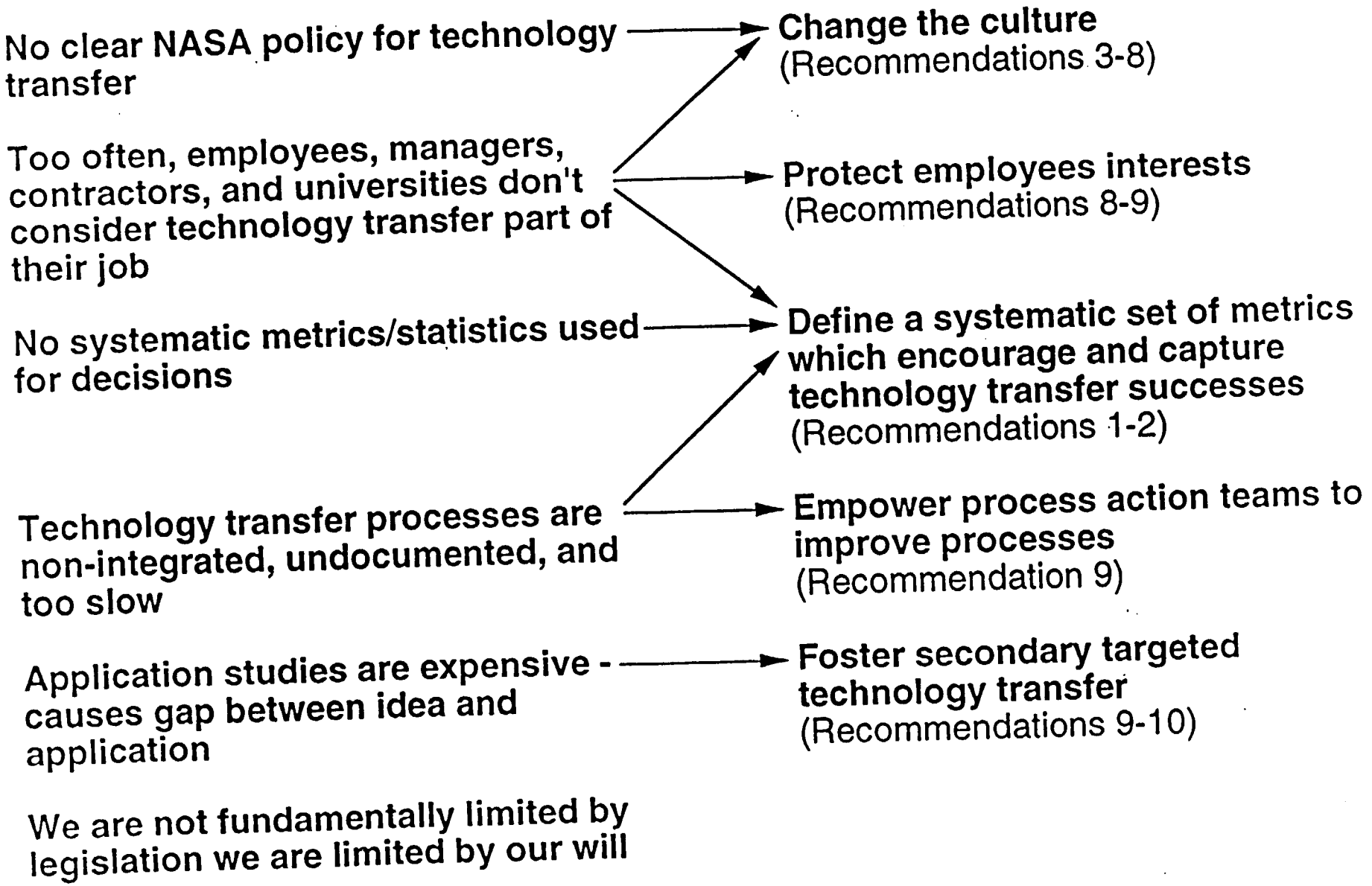
To address the concern that the technology transfer successes are largely anecdotal in nature and are relatively small compared to the potential, a candidate set of metrics has been defined which will capture the successes and provide a basis for continuously improving NASA's technology transfer performance.

As discussed earlier, the team found a number of specific processes which need to be shortened, extensively reformed, or even started from scratch to assist in the improvement technology transfer. Since the people who will be implementing and directly involved in these processes are the best people to define them, the Technology Transfer Team recommends that NASA empower process action teams to improve processes.

Finally, the team feels that there is enormous potential for NASA to benefit the nation through secondary technology transfer but there is little to no (depending on the year chosen) budget to support these activities. Since the payoff to cost ratio is perceived to be so great the team recommends NASA foster secondary technology targeted technology transfer by increasing the funding allocated to this activity and by using several process action teams to improve the Agency's ability to define appropriate secondary targeted transfer activities.

WHY WHAT WE FOUND WAS THERE TO BE FOUND

WHAT WE SUGGEST DOING ABOUT IT



RECOMMENDATIONS

The recommendations are grouped into two categories. The first category discusses NASA elements implementing and being held accountable for technology transfer performance, and has two specific recommendations for accomplishing this. The second category includes eight recommendations for changing NASA's culture to facilitate technology transfer. As mentioned earlier, they are quite specific to facilitate their implementation.

All NASA elements must implement and be evaluated on their technology transfer program.

1. Each center must manage to the recommended metrics or define and manage to a more effective set.

Rather than tell each center *how* to implement a technology transfer program (which would be presumptuous of the team), the team recommends that the metrics developed be considered for use in managing the program. These activity and effectiveness metrics are summarized on Attachment 1. If these metrics are inappropriate and a more appropriate set can be identified, then that set should be used.

2. Headquarters must implement a unified plan to support technology transfer.

There are a number of offices involved in technology transfer. The roles of these offices should be reviewed and integrated to produce the market-oriented, technically-led and legally-supported model of technology transfer that is recommended. There are a number of infrastructure activities that headquarters should provide, including SBIR support, the Tech Brief process, and support for the existing (or an improved) COSMIC.

RECOMMENDATIONS

All NASA elements must implement and be evaluated on their technology transfer program

1. Each center must manage to the recommended metrics (attachment 1) or define and manage to more effective set

2. Headquarters must implement a unified plan to support technology transfer

   Specified roles and missions of each office

   Provide infrastructure activities supporting all centers (SBIR,Tech Brief, COSMIC, . . .)

The remaining recommendations are intended to **institute a proactive effort to change the Agency's technology transfer culture and ensure broader participation by all employees.**

3. NASA should specifically mention technology transfer in the Vision-Mission-Values statement

It is not particularly important to use the specific words that the team developed (see Attachment 2). However, it is very important to send a clear, unambiguous message about the relevance of technology transfer to the Agency's mission. Therefore, the team strongly recommends that the Vision-Mission-Values document explicitly mention technology transfer.

4. Administrator should send a directive...

The similar point is true here. The administrator must send a clear, unambiguous message that technology transfer activities are fully valued, important parts of NASA missions, and that the center directors are accountable to manage their programs accordingly. It is especially important to state specifically that secondary targeted and non-targeted technology transfer activities are important, because they are the most under-valued (and often discouraged) activities. See Attachment 3.

5. Administrator should continue strong technology transfer support and measure overall Agency performance.

The measures for the Agency as a whole are somewhat different from the metrics for the research programs, and as with those metrics, the Agency should manage to the recommended metrics or define and manage to a more effective set. The measures defined and recommended by the team are shown in Attachment 4.

6. Each center should include technology transfer in its mission statement.

The philosophy is the same here for each center as for the Agency as a whole.

RECOMMENDATIONS (con't)

Institute a proactive effort to change the agency's technology transfer culture and ensure broader participation by all employees.

3. NASA should specifically mention technology transfer in V-M-V statement (proposed draft enclosed as attachment 2)
4. Administrator should send a directive to A.A.'s and C.D.'s stating that technology transfer is a mission of NASA and specifically that secondary targeted and non-targeted are fully valued, important NASA missions which should be managed accordingly (proposed draft attached as att. 3)
5. Administrator should continue strong technology transfer support and measure overall agency performance (draft measures attached as att. 4)
6. Each center should include technology transfer in their mission statement
7. Each center should provide technology transfer training for all employees (draft topics attached as attachment 5)
8. Assess, promote, and reward employees according to metrics/contributions

7. Each center should provide technology transfer training for all employees

The team found that employees were uninformed on many aspects of technology transfer. We recommend that the course include information on all of the types of technology transfer activities within the Agency, legal aspects, employee rights and responsibilities, effective outreach to customers, and supporting services for each type of technology transfer. Such a course should facilitate the culture changes recommended by this team. A proposed curriculum is contained in Attachment 5.

8. Assess, promote, and reward employees according to metrics/contributions

Just as the centers should be evaluated based on the metrics, so should the employees. When employees are aware of the metrics and their importance, they will be more likely to work to improve them.

9. Form and empower at least the following process action or process development teams:

We identified several areas where improvement or creation of processes are appropriate, so we suggest that process action teams be formed to address these specific issues. A table is included in Attachment 6 that provides details for each recommended process action team, including motivations and descriptions of recommended participants, goals, and metrics.

10. Secondary targeted technology transfer activities should be proactively sought. The budget allocated to each center for its use in secondary targeted transfer programs should grow and be taken "off the top" as is SBIR.

As stated previously, we found that this is a very under-emphasized part of the technology transfer activities. Since many people do not believe it is part of NASA's charter, there have been cases of researchers actually being discouraged from secondary targeted efforts. However, it is part of NASA's charter, and NASA gets a tremendous amount of benefit from these activities in terms of public perception, so the team recommends that this type of activity be supported. It is of note that this is the only area where the team recommends increased funding.

RECOMMENDATIONS (con't)

9. Form and empower at least the following process action and process development teams: (detail attached as attachment 6)
   - Tech Briefs - information acquisition to publication
   - Patent applications and licensing
   - Software distribution and transfer
   - Conversion of non-targeted to secondary targeted
   - Conversion/integration of primary targeted to secondary targeted
   - Execution of secondary targeted programs

   } Including use of jointly sponsored research activities

   - Define relationship of centers to CCDS
   - Employee motivation and incentive for technology transfer activities

10. Secondary technology transfer activities should be proactively sought. The budget allocated to each center for its use in secondary targeted transfer programs should grow and be taken "off the top" as is SBIR.

SUMMARY

Continuing improvements must be made in NASA's technology transfer performance for NASA to best serve the country

NASA's culture must change to achieve continuous improvement in technology transfer

Implementing the ten recommendations constitutes an important first step in improving NASA's technology transfer performance

ATTACHMENTS

TECHNOLOGY TRANSFER METRICS

	Activity	Effectiveness
Primary Targeted	Proportion (80% optimal) of program endorsed by customer Length of time from development to use	Number of citations Number of acknowledged uses Letters attesting to use/benefits Personnel exchanges Spinoff companies Revenue from patent license
Secondary Targeted	Number of secondary targeted negotiations	Number of successfully completed activities $ reimbursed by recipient Acknowledged benefit of consultation Revenue from patent license
Non Targeted	Requests for TSP packages or info Number of secondary targeted requests	Tech Briefs and TSP's used (survey) Value of COSMIC sales Royalties received Number of acknowledged uses

Attachment 1

PROPOSED TECHNOLOGY TRANSFER MISSION

NASA Vision

As explorers, pioneers, and innovators, we will boldly expand the frontiers of air and space for the benefit of all.

Mission

To achieve this vision we will:

- establish and sustain human presence in and beyond Earth orbit;
- increase scientific knowledge of planet Earth, the solar system, and beyond;
- advance aeronautics and astronautics through scientific and technological research;
- enhance U.S. competitiveness and enable private-sector involvement in aerospace through *proactive technology transfer and* cooperation with industry, academia, and other government agencies;
- encourage scientific education through discovery, example, and outreach.

Values

In fulfilling these missions, we uphold these values:

Integrity - we are open, honest, and accountable for our actions, individually and collectively.

Excellence - we strive to improve and are committed to nurturing a premier NASA team, through recruiting, education and hands-on experience, that consistently and efficiently delivers the highest quality results.

Team work - we work as a team in all endeavors.

Respect for the Individual - we value diversity and will provide a work environment which encourages, stimulates, and empowers all members of our workforce.

Courage - we are bold but prudent in confronting challenges and accepting risks.

Dedication - we are proud of our accomplishments, enthusiastic about our individual contributions, and committed to fulfilling our vision.

Responsibility - we are responsible stewards of the public trust and the environment and are dedicated to providing benefits to society.

Creativity - we foster imagination, innovation, and the free expression of ideas.

To: Officials-in-Charge of Headquarters Offices
Directors, NASA Field Installations
Director, Jet Propulsion Laboratory

From: A/Administrator

Subject: Technology Transfer Directive

One of the most serious challenges to the economic future of the United States is to regain our preeminence in markets driven by emerging technologies. Everything that most Americans hold dear: our quality of life, the environment, national security, foreign policy aims, all hinge upon the restoration of our competitive standing in the global economy. A treasure house of scientific and engineering knowledge resides in our country, that if transferred faster and better to the public and private sectors, can be a major contributor to the creation of a new era in world leadership.

NASA has the reputation of being the leader in technology transfer, but this position has eroded. Our attitude that the transfer of our valuable technology will "just happen" is no longer acceptable; it must be proactively sought and given the highest priority. To be effective we must consider the transfer and dual use of technologies at the outset of any technical undertaking. It must be an integral part of every researcher's, technology developer's, and manager's job. It must be supported by everyone.

In May, I chartered a Special Initiatives Team on Technology Transfer to investigate how we transfer our technology to other government agencies, the aerospace industry, the national economy, and society. In general, the findings stated that although too often NASA employees do not consider technology transfer to be a NASA mission, and that while the resources made available for technology transfer are relatively insignificant, NASA enjoys a reputation of being good at technology transfer. Despite this reputation, our successes are modest compared to the amount of technology we generate. With a new focus, management commitment, and employee empowerment, we can make great improvements in our performance. A significant part of this improvement will result from fostering technology developments in the general economy that serve our needs as well as the needs of the nation. Technology transfer is a fundamental mission, it is important as any NASA mission and it must be pursued.

I support the findings and recommendations of the technology transfer team. I ask you to read this report and send your comments, suggestions, and initiatives to Paul Holloway, who will head and coordinate this effort, including the assignment of Process Action Teams. You will be contacted to prepare plans that will push technology transfer to the top of your agendas. Consider this new emphasis as a major initiative in NASA. Technology transfer will be a way of life, and as Americans, we shall all share in the benefits.

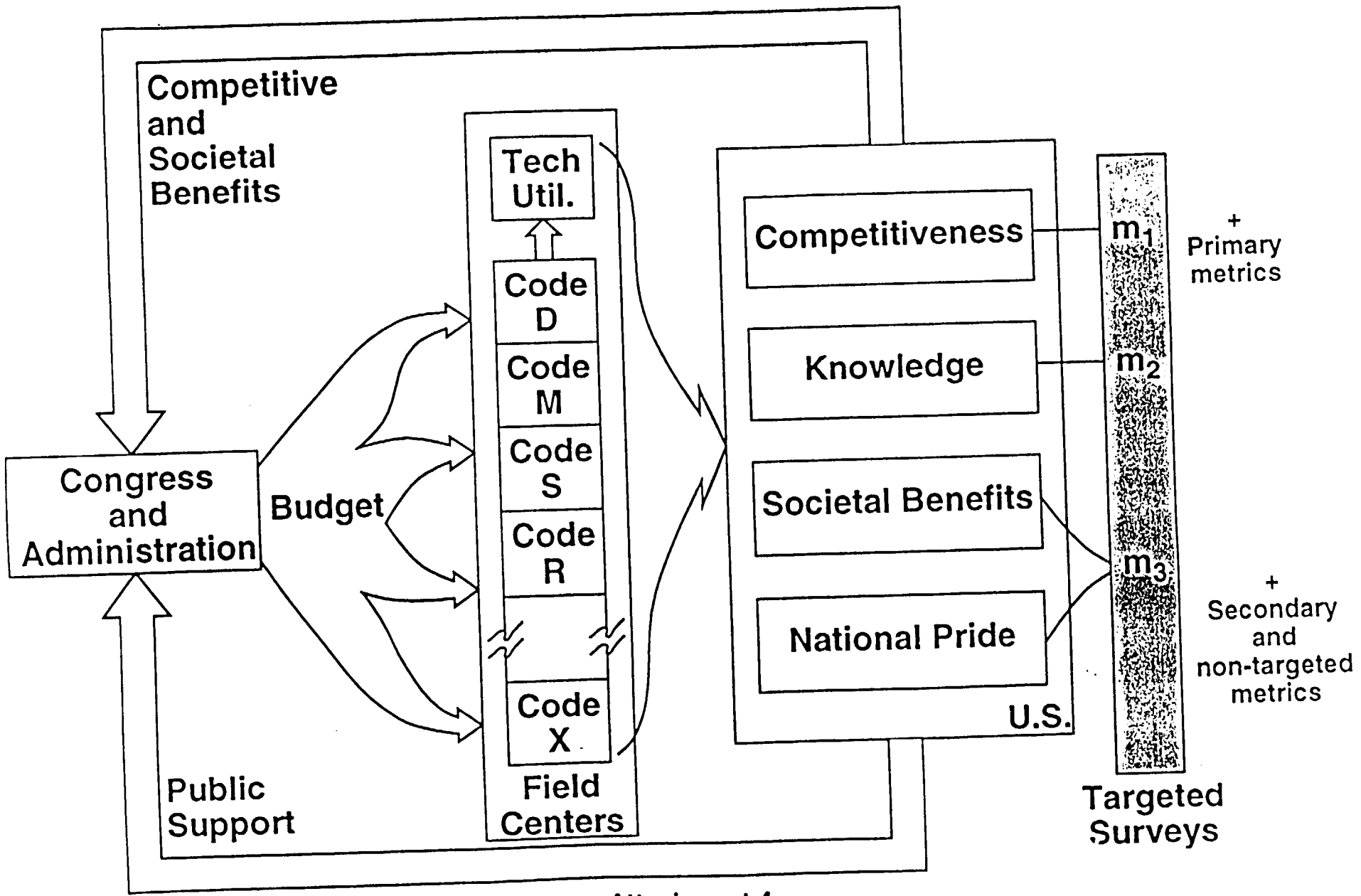
Attachment 3

METRICS FOR CONTRIBUTION TO U.S.

This chart shows the "big picture" of NASA, its constituent parts, the motives, and the measures for technology transfer by the Agency. The goals for transferring technology are: to improve U.S. competitiveness, increase knowledge, provide societal benefits (such as, improved quality of life), and increased national pride. If NASA accomplishes these things, resulting in increased public support, improved competitive position in aerospace markets (e.g., a strong world market position in aircraft manufacturing), and a healthier society, they provide positive feedback to Congress and the Administration.

However, measuring whether these goals have been successfully fulfilled may not be perfectly straightforward. We suggest that measures of success for the Agency as a whole may best be achieved by surveys or polls of the appropriate populations. For example, we should survey members of the aerospace industry to determine whether we are meeting their needs for in the competitiveness arena. Similarly, we should survey the general U.S. population to identify their perceptions of NASA's contribution to the national sense of pride and benefits to society.

METRICS FOR CONTRIBUTIONS TO U.S.



Attachment 4

Technology Transfer Training Course Topics

- Agency mission in Technology Transfer

- Definitions/types of Technology Transfer
  - Primary targeted
  - Secondary targeted
  - Non-targeted

- Legal aspects of Technology Transfer
  - Legislation
  - Intellectual property rights
  - Patents, copyrights, trade secrets
  - Software
  - etc...

- Employee rights and responsibilities
  - Meaning of intellectual property agreement
  - Significance of NASA ownership
  - Proper record keeping and reporting
  - Royalty sharing and financial rewards

- Authorities and responsibilities
  - Developing agreements (no-cost, reimbursables)
  - Outreach
  - Licenses
  - Reports (NTR's tech briefs, etc.)
  - Implementing agreements
  - Restricted information (classified, proprietary, domestic-only)

- Effective outreach to customers
  - Reactive vs. proactive
  - How industry thinks and why
  - How other agencies think and why
  - Interacting with customers throughout the technology development process (requirements, solutions, etc.)
  - Case studies, including successes and failures

- Supporting services for each type of tech transfer
  - Center services
    - TUO
    - Patent Counsel
    - General Counsel
    - Procurement
  - HQ Services
  - National Technology Transfer Network
  - Tech brief network
  - Joint sponsored research

RECOMMENDED PROCESS ACTION TEAMS

In the process of identifying and reviewing the many technology transfer activities in the Agency, several processes appeared to be strong candidates for continuous improvement through use of Process Action Teams. Candidate Process Action Teams identified were:

Tech Briefs - information acquisition to publication
Patent Applications and licensing
Software distribution and transfer
Conversion of non-targeted to secondary targeted
Conversion of primary targeted to secondary targeted
Execution of secondary targeted programs
Define relationship of centers to CCDS
Employee motivation and incentive for technology transfer activities

The facing page lists the subject of the recommended Process Action Team and the type of team. The type of Team was said to be a Process Improvement Team (PIT) when there was an existing process. For several activities, there is essentially no existing process so one must be defined. Since this is a somewhat different activity than process improvement, these teams are called Process Planning Teams (PPT).

Also shown is a recommended set of participants where

"HQ and Centers" means	a single group consisting of HQ and Center representatives.
"Each Center" means	a separate group at each Center, perhaps with some mechanism to share information and ideas.

For each team the motivation or justification is provided, together with metrics to be used for identifying improvement in the process. As with all proposed metrics in this report, we suggest that these metrics be used, or the teams should define a more appropriate set.

RECOMMENDED PROCESS ACTION TEAMS

Team Topic	Type	Participants	Justification/Goal	Metric(s)
Tech Brief Process	PIT*	HQ & Centers (Code C lead)	• 18 months for Tech Brief Process	• Length of Tech Brief Process
Patent Application & Licenses	PIT	HQ & Each Center (Code J lead)	• Long time to issue (18-24 mo.) • Few are licensed	• Time to issue • Number licensed
S/W Distribution & Transfer	PPT**	HQ & Centers (Code C lead & Code R participation)	• Cumbersome doc of s/w • Little/no post transfer support • Few updates provided by NASA • Much s/w developed never gets to COSMIC	• Number of pieces of s/w distrib. • Number of s/w updates distrib. • Improved time to COSMIC • Customer satisfaction
Execution of Secondary Targeted	PIT	Each Center	• Few are done relative to potential	• Recog. by employees as a mission • Increased funding support • Number of activities • Culture change • Number of jointly sponsored research activities
Conversion of Non-Targeted to Secondary Targeted	PPT	HQ & Centers (Code C lead)	• Few occurrences relative to potential	• Number of new starts • Streamline marketing process
Conversion of Primary Targeted to Secondary Targeted	PPT	HQ & Each Center (Code R lead)	• Few occurrences relative to potential • TU & Primary Targeted activities disconnected	• Number of new starts • Streamline marketing process • Number of Primary Targeted activities known by TU
SBIR's	PIT	HQ & Each Center (Code C lead)	• Commercialization potential not exploited	• Revenue earned after phase 3

* Process Improvement Team

** Process Planning Team

Attachment 6

RECOMMENDED PROCESS ACTION TEAMS

Team Topic	Type	Participants	Justification/Goal	Metric(s)
CCDS's	PPT	HQ & Each Center (Code C lead)	• Lack of data on performance/benefits to NASA • Weak links with centers • Relationship with centers unclear	• Working relationship with ctrs
Employee Motivation/Incentives	PPT	HQ & Each Center (Code A appointed lead)	• Very little $ at stake • Very little recognition • No penalty for not doing it • Secondary & non-targeted activities have been discouraged	• Formal rewards/incentives • % of res. time spent on technology transfer